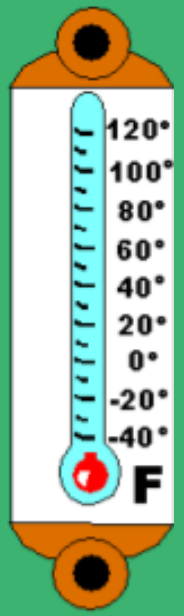
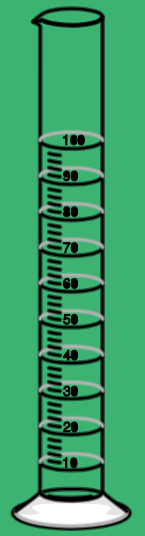
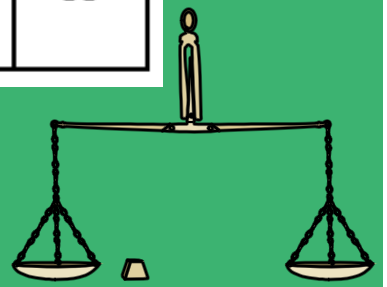
# 1.2 Measuring



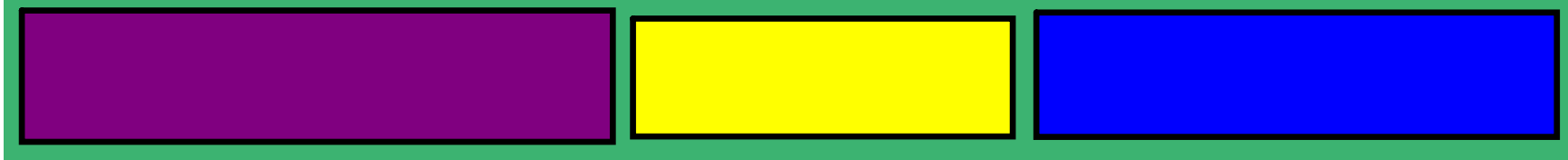




| Curriculum Outcomes | Related Activities | Page in Text |
|---|---|---|
| • determine accuracy and precision of a measurement<br>• demonstrate an understanding of the concerns and issues that pertain to the collection of data | • carry out specific measurement activities using an appropriate level of precision | 9 |
| | • discuss and determine the number of digits students feel confident reading and recording when making the same measurement using scales of different fineness | 9 |
| | • investigate, through measuring activities, possible inaccuracies that produce different results | 10 |
| | • relate precision and the number of significant digits for the same measurement | 11 |
| | • perform measurement calculations and report results with appropriate level of precision and significant digits | 11 |



# Accuracy

If these shapes are measured multiple times by different people, will everyone find the same measurement?



# Precision

Which ruler will give us a more precise measurement of this shape?

# Notes

**Accuracy**: indicates how close the recorded measurement is to the true value. It is dependent upon the user's skill in using the measuring tool.

**Precision**: is the smallest unit that can be measured with confidence using the measuring tool and is determined by the fineness of the scale on the tool.

**Accuracy**

The accuracy of a measurement indicates how close the recorded measurement is to the true value. It depends on the user's skill in using the tool.

When measuring with a ruler, you must start at the 0 mark, and look straight down on the ruler in order to get an accurate measurement.

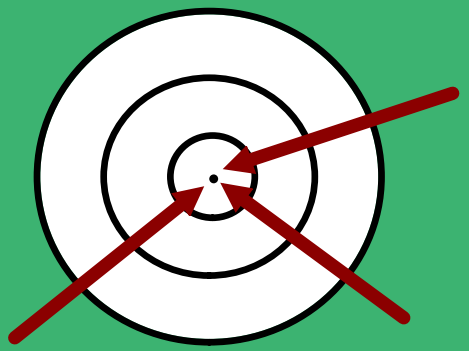
Other factors like temperature, humidity, and the conditions of the tool can also influence accuracy.

**Precision**

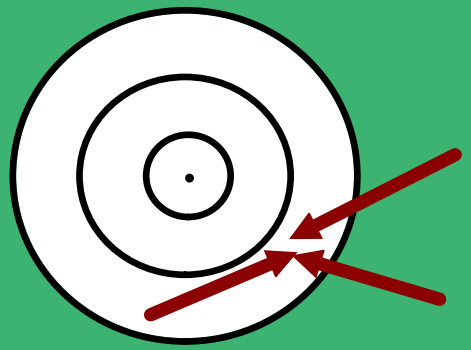
The precision of a measurement is the determined by the size of the units that can be measured with confidence using the tool. The smaller the unit, the more accurate the measurement.

# How are accuracy and precision alike and different?

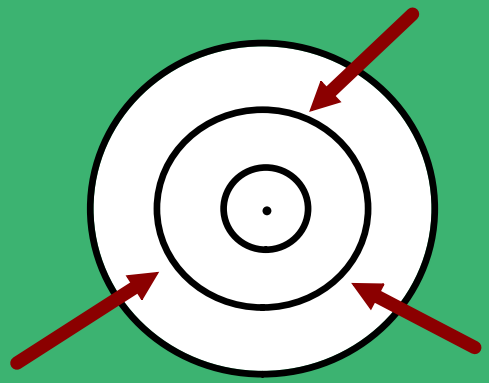
- **Example: Arrows on a target**



Good accuracy
Good precision



Good precision
Poor accuracy



Poor precision
Poor accuracy

# Focus C: Accuracy and Precision

**Accuracy:**

- **three differenct people using same ruler get different answers.**

**Precision:**

- **greater number of digits increases precision.**

## Classwork:

## Do Focus Questions Pg.9 #2,3,4

#2. It is important to use the same tool to measure length and width because then when you find area your answer will be as precise as both measurements.

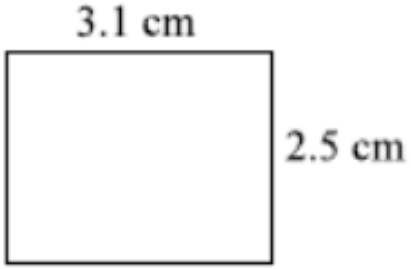
#3. 100.0 tells us that the measurement is EXACTLY 100m, while 100m means that it might have been rounded.

#4. Should the precision of the calculated measurement be considered the same as the least precise measurement????? Explain.

## Why significant digits?

When you do calculations involving measured values, your answer can only be as precise as the least-precise measured value.

Consider the rectangle below. The length and width (3.1 cm x 2.5 cm) are precise to the tenth of a centimetre . If you calculate the area (A = L x W), the result is expressed in hundredths of a centimetre (7.75 $cm^2$). This is a more precise measurement than the original length and width, and is not correct.




So, the area of this rectangle must be expressed as 7.6 $cm^2$.

## Notes

**Significant Digits** can help you make decisions regarding the least precise measured value. This process is understood universally.

### Rules for Significant Digits

1. All nonzero digits (1,2,3,4,5,6,7,8,9) in a measurement are always significant.

| Measurement (cm) | Number of Significant Digits | Measurement (cm) | Number of Significant Digits (fill in answer) |
|---|---|---|---|
| 2.45 | 3 | 5.7 | |
| 34.5678 | 6 | 22391 | |
| 2.1 | 2 | 34993 | |
| 3.456 | 4 | 2.451 | |

2. Zeroes appearing between nonzero digits are significant.

| Measurement (cm) | Number of Significant Digits | Measurement (cm) | Number of Significant Digits (fill in answer) |
|---|---|---|---|
| 10001 | 5 | 100.38 | |
| 30.39 | 4 | 10.4 | |
| 12.0005 | 6 | 200005 | |
| 2.01 | 3 | 7.004 | |

3. Zeroes appearing in front of all nonzero digits are NOT significant.

| Measurement (cm) | Number of Significant Digits | Measurement (cm) | Number of Significant Digits (fill in answer) |
|---|---|---|---|
| 0.0034 | 2 | 0.000 000 000 2 | |
| 0.000 000 05 | 1 | 0.5681 | |
| 0.08734 | 4 | 0.000438 | |
| 0.00405 | 3 | 0.00091 | |

4. Zeros at the end of a number and to the right of the decimal point are significant.

| Measurement (cm) | Number of Significant Digits | Measurement (cm) | Number of Significant Digits (fill in answer) |
|---|---|---|---|
| 3.500 | 4 | 7.00 | |
| 96.0 | 3 | 872.3400 | |
| 5.000 | 4 | 48.00 | |
| 9.0 | 2 | 12.000 | |

5. Zeros at the end of a number which has **no** decimal point are NOT significant.

| Measurement (cm) | Number of Significant Digits | Measurement (cm) | Number of Significant Digits (fill in answer) |
|---|---|---|---|
| 450 | 2 | 34 000 000 000 | |
| 82450 | 4 | 8 657 480 | |
| 5 000 000 | 1 | 600 | |
| 983 000 | 3 | 32 340 000 | |

**Classwork/Homework:**

- Pg. 10 # 6, 9
- Answer "Comparing measuring tools" Questions
- Study the rules for significant digits
- If you finish early, work on the left-hand side of the worksheet.

Compare the measuring tools which are illustrated on page 7 of your textbook.
Answer the following questions.

1. Which tools measure time?

_____

2. Which tool measures time more precisely?

_____

3. Name another tool which measures time.

_____

4. Which tools measure temperature?

_____

5. Which measures temperature more precisely?

_____

6. How could a person make an error in using an ear thermometer?

_____

7. Which tool measures mass?

_____

8. Which tool measures volume?

_____

9. Which measures more precisely - the scale balance or the graduated cylinder?

_____

10. How could a person make an error when using the graduated cylinder?
Would this error affect the accuracy or the precision of the measurement?

_____

_____

## Adding and Subtracting

When adding or subtracting your answer can only show as many decimal places as the measurement having the fewest number of decimal places

Examples:

1) 24.6866 m → 4 decimal places
2.343 m → 3 decimal places
+ 3.21 m → 2 decimal places
30.239 m
↓
**30.24 m** (2 decimal places)

2) 6.201 cm → 3 decimal places
7.4 cm → 1 decimal places
0.68 cm → 2 decimal places
+ 12.0 cm → 1 decimal places
26.281 cm
↓
**26.3 cm** (1 decimal place)

## Multiplying and Dividing

When multiplying and dividing. your answer may only show as many significant digits as the multiplied or divided measurement showing the least number of significant digits.

Examples:

1) 131 m → 3 significant digits
x 2.8 m → 2 significant digits
366.8 m
↓
**370 m** → 2 significant digits

2) 40.02 m → 4 significant digits
13.0005 sec → 6 significant digits

3.078343141 m/sec
↓
**3.078 m/sec** ( 4 significant digits)